THE POSSIBILITY OF USING C3-C4 CALORIMETER LEAK DETECTORS FOR NEUTRON REGISTRATION IN THE GAMMA-400 COMPLEX

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Abstract – The article describes the method for modifying the scintillation calorimeter detectors C3 (S3) and C4 (S4) of the GAMMA-400 space complex in order to obtain the possibility of detecting neutrons produced in the process of passing electrons (positrons) and high-energy protons through detector matter. The presented method allows to increase the rejection factor of background radiation without degrading the basic capabilities of the detectors S3 and S4.

The GAMMA-400 complex (fig. 1) is the project of a space gamma-ray observatory capable of detecting gamma radiation, as well as electron and positron fluxes of high energies. Currently, the GAMMA-400 project is in the process of upgrading the calorimeter system, in particular, the preliminary decision is made to save the S3 and, may be, S4 detector only without neutron detector ND (fig. 2).

The plastic scintillators used in the S3 and S4 detectors can itself be used to register fast neutrons with the help of recoil protons, since has a relatively high concentration of hydrogen atoms (H: C ~ 1.1). Computational model of the neutron detector based on scintillation detector S3 showed in fig.3. Figures 4 a,b show that slowed neutrons can be recorded within 2-500 μs after the pulse of the test neutron generator or passage of shower particles from a high-energy particle (so called master pulse) and fig. 5 shows the amplitude spectra from fast and slow signals.

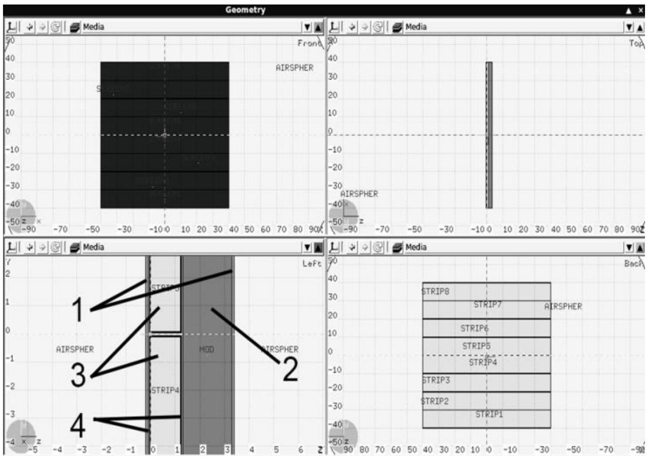

Fig. 3. Computational model of neutron detector based on scintillation detector S3.
1 - aluminum case; 2 - additional layer of moderator;
3 - strips of plastic scintillator; 4 - scintillation screens.

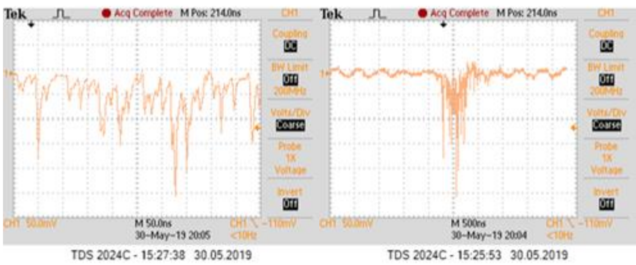

Fig. 4 a.b. Oscillograms for registration of responses from detector containing plastic scintillators without additives, when registering the pulse from the test neutron generator with the duration of 1 μs.

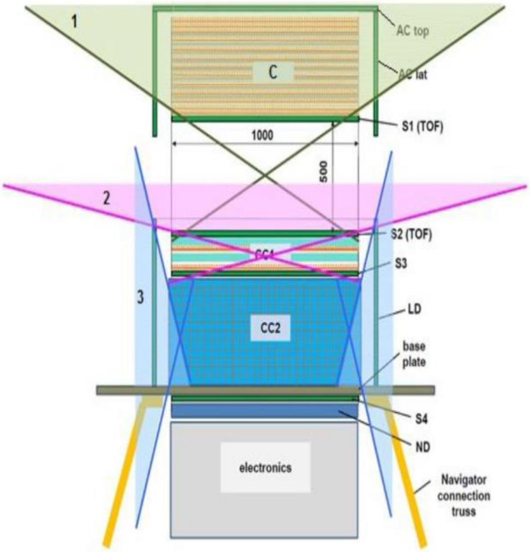

Fig .1. Initial physical scheme of GAMMA-400 complex

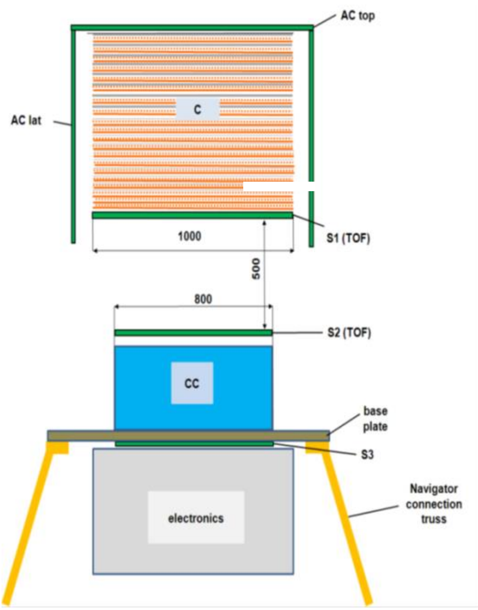

Fig. 2. The modern layout of GAMMA-400 gamma-telescope

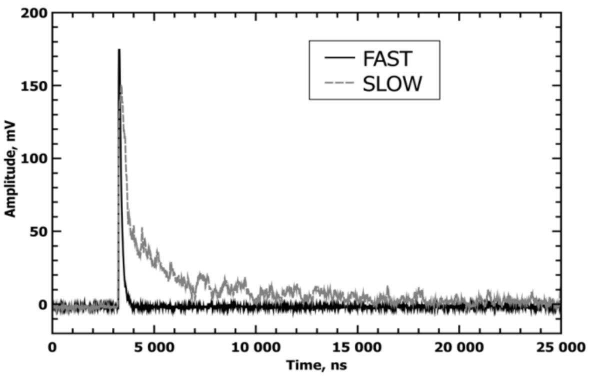

Fig. 5. Oscillograms for registration of responses from detector containing plastic scintillators with polyethylene screens activated by 252Cf . The slow and fast signals (corresponding to delayed and immediate neutrons) are clear seeing.